ANALYSIS OF FRACTURE RESISTANCE OF ENDODONTICALLY TREATED TEETH RESTORED WITH DIFFERENT POST AND CORE SYSTEM OF VARIABLE DIAMETER: AN IN VITRO STUDY.

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CERTIFICATE

This is to certify that this dissertation entitled **"ANALYSIS OF FRACTURE RESISTANCE OF ENDODONTICALLY TREATED TEETH RESTORED WITH DIFFERENT POST AND CORE SYSTEM OF VARIABLE DIAMETER: AN IN VITRO STUDY."** is a genuine work done by **Dr. S.I.JOEPHIN SOUNDAR** under my guidance during his post graduate study period between 2010-2013.

This Dissertation is submitted to THE TAMILNADU Dr. M.G.R MEDICAL UNIVERSTY, in partial fulfillment for the degree of **MASTER OF DENTAL SURGERY IN PROSTHODONTICS & CROWN & BRIDGE - BRANCH I.** It has not been submitted (partial or full) for the award of any other degree or diploma.

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ABSTRACT

Title: Analysis of fracture resistance of endodontically treated teeth restored with different post and core system of variable diameter: an in vitro study.

Mesh Words: Zirconia post, copy milling, fracture strength, post and core, Pressable ceramic

Aim: To evaluate fracture resistance of endodontically treated teeth restored with three all ceramic post and core and one cast post system of 1.4 and 1.7mm diameter.

Materials and methods: Forty eight freshly extracted human maxillary central incisors were endodontically treated they were distributed in four groups of twelve teeth each. Six teeth of each group were taken for 1.4mm diameter and other six teeth were taken for 1.7mm diameter. Group I: Cast metal post of size 1.4 and 1.7mm diameter. Group II: Pressable ceramic post of size 1.4 and 1.7mm diameter. Group III: Prefabricated Zirconia – Cosmo post of size 1.4and 1.7mm diameter. Group IV: Milled Zirconia post of size 1.4 and 1.7mm diameter. All teeth were restored with metal crowns. Specimen of each group was subjected to load to fracture in universal testing machine (Instron model 3345) at a 130 degree angle and the maximum load at failure was recorded. Ducan's Multiple Range (DMR) test was employed as post Hoc tool to compare the Mean value between the four groups with each other of the sub groups

Result: In group I (Ni-Cr) 1.4mm diameter post and cores recorded a maximum fracture load of 534.83±1.28N and 1.7mm showed 294.33±1.02N. In group II (PC) 1.4mm diameter post and cores recorded a maximum fracture load of 205.33±1.61N and 1.7mm showed 375.00±1.57N. In group III (CP) 1.4mm diameter post and cores recorded a maximum fracture load of 313.00±0.73N and 1.7mm showed 638.67±0.81N. In group IV (MZ) 1.4mm diameter post and cores recorded a maximum fracture load of 312.00±0.86N and 1.7mm showed 415.00±0.89N.

Conclusion: Cast metal post and core of lesser diameter (1.4mm) showed higher fracture resistance. Prefabricated zirconia post with pressable ceramic core (Cosmo post) exhibited higher fracture resistance. 1.7mm diameter post shows better results. This post and core system can be considered as ideal material of choice among the tested groups Milled zirconia and prefabricated zirconia post showed same value with 1.4mm diameter post. Milled zirconia is a good option as post and core along with cosmo post in prosthodontics. Pressable ceramic post and core showed satisfactory result with 1.7mm post but showed lesser values with 1.4mm diameter post. Pressable ceramic post and core can also include in prosthodontics for the restoration of anterior teeth.

CONTENTS

LIST OF FIGURES AND TABLES

TABLES

Introduction

INTRODUCTION

When there is extensive loss of coronal tooth structure in an endodontically treated tooth, post and core is often required to retain a complete crown. Metal post and cores are commonly used because of their superior physical properties. Nevertheless, the increased use of all-ceramic crown provides a rationale for tooth colored core. Composite core, prefabricated all-ceramic post with pressable ceramic core, and masking of metal core with opaque ceramic or photo-curing opaque resin are alternatives of tooth colored core. For a ceramic crown with high translucency and thickness of less than 1.6mm, the underlying core color may influence the definitive esthetic result. Cast post may also create root discoloration and blue-gray effect if thin bone and gingival tissue are present[33,40,49,50].

Failures of composite post and core can often occur as a result of their insufficient physical and mechanical strength. The endodontically treated teeth restored with post and core can produce stresses concentrated at the coronal third of root and at the interface of post and core material. If the moduli of elasticity differ between materials, there is potential for separation of core from the post. A study demonstrated that prefabricated post with direct core made of glass ionomer, composite resin, and silver amalgam are less reliable than 1-piece cast post and core, primarily because of delamination at the interface between the post and core[40].

Use of zirconia as a post and core material began in 1993 when introduced by Mayenberg et al[40]. Prefabricated zirconia post present positive qualities, such as high strength to bending forces and appropriate optical properties. However, prefabricated zirconia posts have been used with pressed ceramics or adhesively luted composite resin and core materials, creating several problems in the long term, most commonly, core delamination. Also available diameter of most esthetic post systems do not permit a conservative post space preparation, which is especially important for mandibular incisor, maxillary first molars and lateral incisors. With these teeth, a custom made post may help to preserve tooth structure.

Optimal modulus of elasticity of post is controversial. Stiffer posts and cores may improve support of the coronal restoration and provide a more uniform distribution of stress, but if overloaded, they can result in catastrophic failure modes, such as vertical root fracture. A more flexible post may blend under high loads, which may cause failure or loss of the restoration, but could potentially leave the root intact for retreatment. Nevertheless, a no rigid post may allow micro motion of the core, causing breakdown of the luting cement and coronal leakage[49,50].

The technique for milling a 1piece zirconia post and core has been described by Awad , Marghalani and streaker, geissberger[29]. The authors used computer aided design/ computer aided manufacturing technology to fabricate yttrium-tetragonal zirconium polycrystalline ceramic post. The authors stated that this technique provide a post and core with grater toughness, maximal adaptability to the canal and adequate esthetics.

Pressable ceramic post and core is also added in this study as a test material because of reduced cost and ease of fabrication. The average biting forces on anterior teeth are 222 N[48]. Post and core systems need to with stand forces greater than 222 N to ensure success of the restorations for the anterior segment and hence.

The purpose of this in vitro study was to evaluate fracture resistance of endodontically treated teeth restored with three all ceramic post and core system and one cast post system of two different diameter.

Aims of the Study

AIMS AND OBJECTIVES

The aim of this study was:

To evaluate fracture resistance of endodontically treated teeth restored with three all ceramic post and core system - ***Prefabricated zirconia post, milled zirconia post, pressable ceramic post*** and one cast post system **–** ***Ni-Cr post*** of 1.4 and 1.7mm diameter.

Review of Literature

REVIEW OF LITERATURE

Ross L. Neagley et al1969[1] demonstrated that root canals sealed with the lateral condensation of gutta-percha showed no adverse leakage effect due to dowel preparation. Root canals sealed by the warm gutta-percha technique presented a slightly increased incidence of leakage following dowel preparation.

Anthony H. L. Tjan et al 1985[2] evaluated that dentin walls were apparently more prone to fracture under horizontal impact than those that had 2 or 3mm of buccal dentin walls. Contrary to popular belief, the addition of a metal collar did not enhance the resistance to root fracture.

John A. Sorensen, et al 1990[3] demonstrated that one millimeter of coronal dentin above the shoulder significantly increased the failure threshold. The preparation of the coronal walls should be parallel for maximum resistance form. The contra-bevel design at either the tooth-core junction or the crown margin did not improve the failure threshold. The axial width of the tooth at the crown margin did not significantly increase the fracture resistance or alter the failure threshold.

Arturo Martinez-Insua et al 1998[4] demonstrated that significantly higher fracture-threshold values were obtained in the cast-post and core group. Teeth restored with carbon-fiber posts and composite cores typically showed failure of the post/core interface before the fracture of the tooth occurred. This failure occurred in response to acceptably high loads.

N.Hochmanet al 1999[5] demonstrated that the post is not as important a restorative feature as the placement of the crown. The Cosmo-post dowel or a similarly shaped prefabricated post is contraindicated in teeth with canals of unusually large diameters, which are not round. One disadvantage of the Cosmo post dowel isthat it is only available in 2 diameters. The 1.4 mm diameter post is suitable for many endodontically treated teeth, whereas the 1.7 mm diameter is less versatile because of its large diameter.

Lawrence W. Stockton et al 1999[6] demonstrated that retention and resistance to fracture are two important factors that must be achieved with post and core retained restorations. Nevertheless, retention often requires the removal of tooth structure, a procedure that may reduce the strength of the root. When placing a post, the dentist must evaluate each tooth individually to determine the best approach to obtaining the maximal fracture resistance. A variety of post systems are suggested to achieve the optimal balance between post retention and resistance to root fracture. This flexible approach should allow the dentist to successfully restore most endodontically treated teeth.

SonthiSirimai et al 1999[7] stated that addition of polyethylene woven fibers resulted in significantly fewer vertical root fractures in post-and core treated teeth. The use of a prefabricated post with a smaller diameter combined with polyethylene woven fibers resulted in significantly fewer vertical root fractures than those recorded for teeth restored with cast posts and cores. The use of a prefabricated post with a smaller diameter combined with polyethylene woven fibers and a composite core resulted in significantly higher resistance to fracture than that recorded for teeth restored with the polyethylene woven fiber and composite core without a prefabricated post. No significant differences in resistance to fracture were demonstrated between teeth restored with prefabricated posts with composite resin cores and those restored with undersized prefabricated posts with polyethylene woven fiber and composite cores. The polyethylene woven fiber–composite core buildup was the weakest post-core system and the traditional cast post & core was the strongest.

Seung-MiJeong et al 2000[8] stated that in regard to the high fracture resistance of zirconia post, adhesive cementing the core build-up to the post offers a viable alternative to the conventional pressing technique. The elastic bond between the rigid high-strength zirconia post and the core build-up presents an additional advantage.

Clarance J. Cormier et al 2001[9] demonstrated that fibre posts did not cause tissue & root discoloration like other conventional posts. The fibre posts were readily retrievable from failure where as conventional post systems were non-retrievable.

Guido Heydecke et al 2001[10] stated that the reconstruction of endodontically treated single rooted teeth with approximal cavities can be successfully performed by closure of the endodontic and additional cavities with composite. Cementation of endodontic posts offers comparable but no advantageous fracture resistance. Enlargement of the root canal space after completion of endodontic treatment should be avoided and cannot be compensated for by injection of composite resin. Less catastrophic failures were. observed without post reconstruction.

Joachim Tinschert et al 2001[11] Demonstrated that in comparison with fixed partial dentures consisting of conventional dental ceramic materials, the mean failure loads were almost three times as high. After veneering, the fracture resistance of the fixed partial dentures increased even further. The mean failure loads of pure substructures were significantly lower than those evaluated for the veneered fixed partial dentures.

Frank Butz et al 2001[12]evaluated that prefabricated titanium posts with composite cores, zirconia posts with heat-pressed ceramic cores and cast posts and cores yield comparable survival rates and fracture strengths for the restoration of crowned maxillary incisors with moderate coronal defects. The results for zirconia posts with composite cores are significantly lower. Zirconia posts with ceramic cores exhibited less vertical fractures than metal post combinations. The combination of zirconia posts with composite cores cannot be recommended for clinical use.

Guido Heydecke et al 2002[13] evaluated that the traditional cast post and core technique is more time consuming and frequently involves greater laboratory and material costs. If the quality of treatment is comparable, direct core restorations can reduce both time and financial burdens on the patient. The body of literature on the clinical success of post-retained cores is scarce. Randomized controlled trials are needed. Future laboratory studies should focus on which treatment modality is appropriate for teeth with different degrees of teeth loss.

Guido Heydecke et al 2002[14] stated that zirconia posts with ceramic cores can be recommended as an esthetic alternative to cast posts and cores in the anterior region. If a chair side procedure is preferred, zirconia or titanium posts with composite cores can be used as an alternative to cast posts and cores.

Steven A. Aquilino et al 2002[15] stated that RCT (Root Canal Treatment) teeth without crowns were lost at a 6.0 times greater rate than teeth with crowns when tooth type and the presence of caries at access were controlled. Second molars and teeth with caries at the time of access also were lost at a greater rate.

BegümAkkayan et al 2002[16] Stated that the titanium system demonstrated the least resistance to fracture loads and the most catastrophic failures. Significantly higher fracture resistance was observed in teeth restored with the quartz fiber matrix system. The mean fracture loads of the glass fiber matrix system and zirconia system did not differ. However, they were significantly higher than the loads recorded for the titanium group and lower than the loads recorded for the quartz fiber matrix group. All specimens in the zirconia group fractured. Statistical analysis of the mode of fracture showed that the quartz fiber and glass fiber groups fractured favorably. Catastrophic fractures were observed in the titanium and zirconia groups.

Aquaviva S. Fernandes et al 2003[17] demonstrated that an ideal post system should have the features like physical properties similar to dentin, maximum retention with little removal of dentin, distribution of functional stresses evenly along the root surface, esthetic compatibility with the definitive restoration and surrounding tissue, minimal stress during placement and cementation, resistance to displacement, good core retention, easy retrievability, material compatibility with core, ease of use, safety and reliability and reasonable cost. Therefore, the clinician should be knowledge able in selecting the right type of post and core systems to meet the biological, mechanical and esthetic needs for each individual tooth.

Lu Zhi-Yue et al 2003[18] demonstrated that different post-core systems and different amounts of ferrule length would influence the fracture resistance of endodontically treated maxillary central incisor teeth restored with porcelain fused metal crowns. Both prefabricated and custom cast posts were parallel-sided post systems; however, when teeth with a 2-mm ferrule were tested, teeth restored with a custom cast post-core system performed better than those with a prefabricated post and resin core system.

Richard S. Schwartz et al 2004[19] stated that titanium alloys are relatively weak and may be subject to fracture in thin diameters. They are more difficult to retrieve than other metal posts. Active, threaded posts should only be used when maximum retention is required. They impart stress into the root structure and are difficult to retrieve. Ceramic and zirconium posts are not retrievable in most cases and should be avoided.

A. Monzavi1 et al 2004[20] demonstrated that there were not significant differences stress distribution pattern and magnitude in dentinal wall between the three theories of post diameter (Conservational, Proportional, Preservational) and depend on root canal conditions and tooth. Tensile and compressive stresses in dentin were decreased only by 2.5% and 7.1% respectively, when the post diameter increased from 1.1mm to 2.6mm in cement-enamel-junction portion. When the post diameter increased from 1.1mm to 2.6mm in cement-enamel-junction portion tensile and compressive stresses in Post were increased by 100% and 66% respectively. Because the amount of stresses generated in post increased by increasing the post diameter, the use of narrowest post possible is recommended.

Ingrid Peroz et al 2005[21] stated that adhesive fixation is preferable as it produces a higher fracture resistance in comparison to cemented posts & cores. Moreover, it offers a higher leakage resistance.

Philip L.B. Tan et al 2005[22] evaluated that the mean fracture strengths of endodontically treated maxillary central incisors restored with a crown without a dowel and endodontically treated maxillary central incisors restored with a cast dowel and core and crown with a uniform 2-mm ferrule were not significantly different. Endodontically treated maxillary central incisors with a uniform 2-mm ferrule were more fracture resistant than those with a ferrule varying between 0.5 mm and 2 mm. Endodontically treated maxillary central incisors with a ferrule length varying between 0.5 mm and 2mm were more fracture resistant than those without a ferrule.

Erik Asmussen et al 2005[23] evaluated that bonded dowels and parallel-sided dowels resulted in less dentin stress than non-bonded dowels and tapered dowels. Dentin stress was reduced with increasing diameter and modulus of elasticity of a bonded dowel. A decrease in dowel length increased dentin stress but shifted the maximum stress to a location apical to the dowel.

Zhang yu-xing, Zhang wei-hong et al 2006[24] Analyzed Fracture resistance of custom- fabricated celay all ceramic post and core restored endodontically treated tooth. Celay post core restored with 2.0mm dentine ferrule and cast metal post core restored with 2.0mm dentine ferrule have similar fracture strength. There was statistically difference between the fracture resistance of celay post core restored with and without dentine ferrule.

M. Sadeghi 2006[25] demonstrated that significantly higher fracture resistance was recorded in the cast post and core group. Teeth restored with zirconia fiber and quartz fiber posts and composite cores showed core fracture. By contrast, teeth restored with cast post and core showed fracture of the tooth. A more favorable mode of failure through composite cores was observed in teeth restored with zirconia fiber and quartz fiber posts.

Linards Grieznis et al 2006[26] stated that qualitative endodontic treatment is a prerequisite to a successful treatment of the ETT. Post and cores significantly reduce the fracture resistance of the tooth and should be used only to secure retention and resistance form for full coverage crowns. One of the main goals in endodontic treatment and post-core preparation is to preserve as much tooth material as possible. Teeth with a larger diameter post have a reduced fracture resistance than teeth with a smaller diameter.

Mikako Hayashi et al2006[27] stated that under conditions of vertical and oblique loading, the combination of a fiber post and composite resin core with a full cast crown is the most protective method for maintaining tooth structure. Fracture resistance of pulpless molars with respect to residual tooth structure also needs to be investigated to confirm the most effective restorative method for protecting and reinforcing pulpless molars.

Sung-Ho Jung et al 2007[28] evaluated that the microleakage in the Para-Post, FRC Postec, and Cosmo post groups was significantly lower than microleakage measured in the cast post and core group. Both the Cosmo post and FRC Postec groups showed fracture patterns that would favor retreatment. The Cosmo post group recorded the lowest number of load cycles to failure.

Ai B Streacker. Marc Geissberger et al 2007[29]**.** Describe procedure that requires the same amount of time as a conventional cast metal post and core but result in the fabrication of a milled Zirconium post and core to achieve a high level of strength and esthetics using an all ceramic definitive restoration.

HaiQing et al 2007[30] stated that with a 2.0-mm ferrule, endodontically treated anterior teeth restored with glass fiber and zircon posts and composite resin cores exhibited significantly lower failure loads than those with cast nickel-chromium alloy posts and cores. All specimens displayed root fractures, most of which were oblique, with cracks initiating from the palatal margin of the crown and propagating in a labial and apical direction.

Pérez et al 2007[31] demonstrated that some parameters have on post design for endodontically treated teeth. One such conclusion is that threaded posts most favor retention, followed by cylindrical posts, with tapered posts providing less retention. On the other hand, posts must be as long as possible to improve retention, although a certain length of gutta-percha is recommended for the apical seal. Post diameter must be limited to avoid any weakening of the root dentine. As regards the material, fiber posts provide Restorations of a resistance that is less susceptible to the choice of the length or diameter of the post and facilitates subsequent retreatments in case of failure**.**

Ahed M. AL-Wahadni et al2008[32] stated that teeth restored with titanium posts demonstrated higher resistance to fracture when compared to carbon fiber post and glass fiber post. There is no statistically significant difference between forces required to fracture teeth restored with glass fiber posts and carbon fiber posts and most of the failure modes were catastrophic in nature with the teeth being non-restorable.

Nikolai Stankiewicz et al 2008[33] stated that supra-marginal dentine, when engaged by a cast crown, results in a ferrule effect. The ferrule effect acts to

Protect the underlying tooth and improves the resistance of the restoration to failure.

Polly S. Ma et al 2009[34] stated that teeth with a 0.0-mm ferrule survived few fatigue cycles despite the fact that both the post and crown were bonded. Teeth with a 0.5-mm ferrule demonstrated a significantly higher number of fatigue cycles than the no ferrule group. Teeth with a 1.0-mm ferrule showed a significantly higher fatigue cycle count than the no-ferrule group, but were not statistically different from the 0.5-mm ferrule group.

N.Azadzadeh et al 2009[35] stated that the most fracture load level was achieved with the FRC post. Composite post & celluloid crown. in this situation metal crown does not enhance the fracture strength.

B. H. Kıvanc¸ ,et al 2009[36] stated that the cast post group had a higher fracture strength than resin groups. The force required to fracture the roots was similar for all fibre post systems.

John D. McLaren et al 2009[37] stated that the mean flexural modulus (stiffness) of the stainless steel Para Post XP was significantly higher when compared with the mean of either the fiber-reinforced Light-Post or Snow light post. The stainless steel Para Post XP groups had a significantly higher mean initial fracture load when compared with the Light-Post and Snow light groups. The 10-mm post length groups had significantly higher mean initial fracture loads when compared with the 5-mm post length groups. The mode of initial failure for all groups was core debonding from the tooth. The mode of ultimate failure for groups varied. The stainless steel posts had an incidence of 25% root fractures, while no root fractures were observed with fiber-reinforced posts.

Alessandro RogérioGiovani et al 2009[38] evaluated that in relation to the length, cast posts did not differ significantly in terms of the compressive load required to fracture the root. The 10-mm-long glass-fiber group demonstrated significantly higher values of fracture resistance and the 6-mm-long glass-fiber group showed the lowest values for the force resulting in root fracture.

Zeynep et al 2010 [39] stated that main advantages of zirconia material lie in its translucency and tooth-colored shade, there by rendering the material usable with all-ceramic crowns in the anterior region. In particular, a patient who has a high lip line and thin gingival tissue would require the use of a zirconia post with an all-ceramic crown to optimize the esthetic effect at the root, while maintaining an adequate level of strength. In addition, zirconia is indicated for teeth with severe coronal destruction, because composite materials lack the strength to resist deformation when used to support crowns. Zirconia is not indicated for patients with bruxism. Besides, it is almost impossible to retreat teeth restored with zirconia posts because it is too difficult to grind away the zirconia post and remove it from the root canal. Post space preparation principles for zirconia posts are similar to other post systems. The clinician must have the fundamental knowledge of root canal configuration to avoid excessive shaping. Drills should be used in low speed to reduce the risk of perforation. Length of the post should be two-third of the root canal length and post space preparation should not disrupt the integrity of the remaining root canal filling. If a small diameter post had to be used, a more rigid post system such as zirconia would be advantageous.

Nurit Bittner et al 2010[40] evaluated that all of the systems evaluated Present adequate and satisfactory mean load-to-failure values for restoration of anterior teeth. One-piece milled zirconia post sand cores demonstrated mean load bearing capacity comparable to that of the cast gold posts and cores. Prefabricated posts and cores (titanium posts with composite resin cores and combined zirconia/glass fiber-reinforced posts with composite Resin cores) recorded statistically significantly higher load-to-failure values When compared with the milled zirconia custom-made posts and cores.

MalathiDayalan et al 2010[41] stated that zirconium oxide posts showed higher fracture strength when compared to glass fibre posts. Posts fabricated using CAD CAM showed a percentage error (3.59%) when compared with Glass fibre posts in length.

Srividya S. et al 2010[42] stated that while restoring anterior teeth with all ceramic crowns, an esthetic post system such as zirconia post fabricated using CAD/CAM technology is a viable option for providing the patient with good esthetics without sacrificing strength. The procedure of obtaining a CAD/CAM post is relatively simple if an accurate resin pattern is made.

Nina Beck et al 2010[43] stated that copy milled zirconia ceramic posts demonstrate significantly lower fracture load values as compared to prefabricated zirconia ceramic posts. As no difference in fracture load between prefabricated fiber-reinforced composite resin posts and copy-milled zirconiaceramic posts could be detected, it appears that, from a mechanical point of view, these post types are similarly suited for clinical use.

Shu-Fen Chuang et al 2010[44] demonstrated that the endodontically treated tooth was not strengthened by increasing post length, regardless of whether metal or fiber posts were used. Using long metal posts may reduce the fracture resistance of restored teeth when additional root canal instrumentation is required for the post extension. The fracture patterns of the teeth were found to be associated with the post materials, while the post length had less influence on either the fracture strength or patterns. Fiber posts may provide comparable strength and more favorable fracture patterns at the cervical regions compared to the metal prefabricated post.

JasjitKaur et al 2011[45] stated that significantly higher fracture resistance Was recorded in the group III custom cast post system than teeth restored with other two systems. The titanium post system showed less fracture resistance as compared to teeth restored with custom cast post and core system and the most catastrophic failures. A more favorable mode of failure was observed in teeth restored with Group I glass fibre post system. Teeth restored with group III custom cast post system showed catastrophic vertical root fractures.

Jens T. Mangold et al 2011[46] stated that the fracture resistance of endodontically treated premolars was dependent on the number of residual coronal dentin walls. Placement of a glass-fiber post had no significant influence on the mean fracture resistance of endodontically treated premolars with 3 and 2 remaining cavity wall. The fracture resistance of endodontically treated premolars with only 1 or no remaining cavity wall was significantly increased by the provision of a glass-fiber post.

VaidyaVidya N et al 2011[47] evaluated that no statistically significant difference was observed in the resistance to fracture between teeth restored with cast post and core and either groups of intraradicular resin reinforcement followed by placement of Luminex titanium post or Luscent anchor post. The groups of intra-radicular resin reinforcement showed failure at the post/core interface, sometimes showing fracture of the core along with some part of the tooth-core interface. No radicular fractures were seen, thereby making the teeth more amenable to retreatment. A cast post and core can cause areas of stress concentration making the endodontically treated tooth susceptible to vertical & oblique direction fracture, deeming the tooth non-restorable. Luminex and Luscent Anchor post Systems that utilize placement of composite resin to replace the lost intra-radicular tooth structure prior to the placement of metallic and glass fibre post respectively, have the potential to reinforce teeth.

Materials and Methods

MATERIALS AND METHODS

Sample group

GROUP	POST SYSTEM	MATERIAL	DIAMETER (mm)
Group I	Cast metal post (HI-Chrome soft – 7, High dental, japan co.,Ltd)	Ni-Cr	1.4 and 1.7
Group II	Pressable ceramic (E-max, Ivoclor Vivadent AG, Germany)	Lithium disilicate (LS_2) glass-ceramic	1.4 and 1.7
Group III	Prefabricated zirconia (cosmo post. Ivoclor Vivadent AG, Germany)	zirconium oxide ($ZrO2$) ceramic post and lithium disilicate glass ceramic core.	1.4 and 1.7
Group IV	Milled zirconia (Amann Girrbach America, Inc. USA)	Ceramill zi - Presintered Y-TZP zirconium-oxide blanks	1.4 and 1.7

SELECTION OF TEETH

Forty eight human maxillary central incisor teeth which were freshly extracted for therapeutic reason was selected for this study. Teeth were selected for similarity in size shape and root anatomy. The hard and soft deposits were removed with hand scaling instrument. Equal size tooth were selected by measuring the buccolingual and mesiodistal diameter of tooth at the cementoenamel junction using verneir caliper, so that the teeth of similar dimensions could be evenly distributed between groups.

The teeth were stored in artificial saliva (Wet mouth. ICPA Health Product Ltd, India) except during restoration and experimental testing Buccolingual radiograph of teeth was taken securing all teeth on to a base plate wax sheet (Cavex. Cavex Holland BV, Netherlands) which was of similar dimension of a lateral cephelograph radiographic film. Teeth were numbered on wax sheet to facilate identification and placed on to the cartridge containing a radiograph film thus allowing radiography of multiple teeth with a single exposure. The radiograph was examined for root morphology to confirm similarity in root canal diameter, and also examined for internal root resorption, root fracture, calcified canal.

They were distributed in four groups of twelve teeth each. Six teeth of each group were taken for 1.4mm diameter and other six teeth were taken for 1.7mm diameter. The coronal portion of all forty eight teeth (15mm from the apex (Fig: 9) of teeth horizontally 2mm coronal to cement enamel junction) were removed using a diamond disc mounted on micromotar hand piece (marathon. SAE YANG CO, korea).

ROOT CANAL TREATMENT AND OBTURATION

Ascess cavity preparation was carried out using ISO standard No 10 (SS White,USA) bur using airotor hand piece. The content of the canal was removed with a barbed broach (Pfiffer Dent, Sallanches). The root length was determined by inserting a #10 K (Mani, Japan) file in to the canal the file could seen emerging from the apical foramen. The root canals were instrumented using K file with saline irrigation. Biomechanical preparation is done by step back technique to an ISO file size #50 K file. During instrumentation irrigation was performed with sodium hypochlorite root canal irrigant. The canal were dried with absorbent paper point.

A #50 size gutta-percha (Coltene/Whaledent. Inc, USA) master cone was standardized for 48 specimens. The obturation was done by vertical and lateral condensation of gutta-percha using zinc oxide eugenol (DPI, the Bombay Burmah Trading Corporation, Ltd, Mumbai) as sealer (Fig: 11). The excess was removed with the heated instrument and canal orifice is sealed with temporary cement (DPI, the Bombay Burmah Trading Corporation, Ltd, Mumbai). The samples were returned to artificial saliva storage medium.

POST SPACE PREPARATION

Post space preparation of length 11mm for all teeth was initiated after 7 days. Paeso reamer (Mani, Inc, Japan) of size #2 was used to remove gutta-percha up to middle 1/3rd. Root canal of all sample ensuring that 4mm of intact gutta-percha was left behind in apical 1/3rd of root.

Initial enlargement of root canal was prepared with paeso reamers (Mani Inc, japan) of size #3,4, and final post space preparation was done by using 1.4mm diameter cosmo post drill (red) (Ivoclar Vivadent AG, Germany) for 1.4mm specimen and 1.7mm diameter cosmo post drill (black) for 1.7mm specimen (Fig: 6). Thus post space diameter of 1.4mm and 1.7mm diameter and post space length of 11mm was standardized. Debris was removed using normal saline and dried with paper point.

FERRULE PREPARATION

Parallel wall of dentine extending coronal to the shoulder of the preparation. It is possible that the extension of dentine when encircled by a crown provide a protective effect by reducing stress with in a tooth. 2mm ferrule with 1mm shoulder finish line was prepared using diamond bur of head size ISO no 010 (SF 41, Mani. Japan) (fig: 10).

PREPARATION OF RESIN PATTERN.

After post space preparation, resin pattern is prepared for 1.4mm diameter post and 1.7mm post separately using pattern resin (Fig: 12,13,14) (GC Corporation. Tokyo, japan). The core height of all groups is standardized as 5mm. Resin pattern of post and core made for cast post, pressable ceramic post, and milled zirconia. For cast post (HI-Chrome soft – 7, High dental, japan co.,Ltd)(Fig: 2) and pressable ceramic post (Programat EP3000, Ivoclor Vivadent AG, Germany)(Fig: 3,4) the resin pattern used for lost wax technique for the fabrication of post, where as in the fabrication of milled zirconia the resin pattern is scanned in copy milling machine (Ceramill multi-X, Amann Girrbach America, Inc. USA) (Fig: 7) and post milled by using zirconia blocks (Ceramill zi. Amann Girrbach America, Inc. USA)(Fig: 8). For cosmo post, pattern is made directly on the prefabricated zirconia post (Fig: 5) (Ivoclar Vivadent AG, Germany) of standard size 1.4mm and 1.7 mm diameter and core is made by pressable cermic (E-max, Ivoclor Vivadent AG, Germany) by lost wax technique (Fig: 15,16,17,18) .

CEMENTATION

Cementation of post is done by using resin cement (multilink K. Ivoclar vivadent AG, Germany)

Post preparation:- All fabricated post is wipe with cotton soaked in sprit before cementation. Metal/zirconia primer is applied on cast metal and zirconia post, Monobond-S is applied on pressable ceramic post using applicator tip and air dried in compressor air.

Root canal preparation:- Root canal is irrigated by saline and dried using paper point. Mix Multilink-N primer A+B in 1:1 ratio and applied in to the canal using applicator tip.

Cementation:- Mixing tip is attached to the resin cement cartridge Multilink-N and canal were coated with resin cement by using #2 lentulo spirals (Paste carriers, Mani. Inc, Japan). The post is coated with the same cement and inserted in prepared canal. A static load was applied until the cement set completely for minimum 10min.

IMPRESSION AND DIE PREPARATION

After all group were fitted with their post, they were prepared for full coverage crown restoration by maintaining the 2mm ferrule. A 1mm shoulder was maintained around the tooth. Dies were made of each tooth using PVS impression material (Exaflex. GC America inc,U.S.A). The impression material was allowed to set for 10min and then poured in Type IV stone (pearl stone. Asian chemicals, Gujarat)

WAX PATTERN PREPARATION FOR CROWNS

Each crown was waxed (uniwax, delta labs, india) to the height of 10mm, mesiodistal width 8.5mm and buccolingual width 7mm. wax pattern were spured and invested in Deguvest ^{R}impact (dentsply international company, Germany) investment according to manufacture instruction. All coping casting were made using the same alloy (HI-Chrome soft – 7, High dental, japan co.,Ltd) used for cast metal post and core (Fig: 19).

CEMENTATION OF COPING

The coping were cemented with glassinomer luting cement (GC- Gold label, GC corporation, japan) All cementation procedures were kept under a constant load after complete seating until complete cement setting occurred.

SPECIMEN PREPARATION FOR TESTING

The teeth were attached to surveyor to align the long axis and invested in auto polymerizing resin (DPI-RR cold cure. The Bombay Burmah Trading Company,Ltd. India) at a level of 2mm to 3mm below margin of the preparation to simulate the biological width. Tooth is mounted on acrylic block of size 1.5×1.5mm and is fitted in to the jig used for testing the specimen (Fig: 20).

All teeth are stored in artificial saliva before tested.

LOAD FAILURE

The specimen of each group were subjected to compressive test in universal testing machine (Fig:21) (Instron model 3345) A jig was used to standardized the position of specimen at the base of the apparatus so that the load could be applied at the angle of 130^{o} in relation to long axis of the post

(Fig: 22), An increasing oblique compressive load was applied 2mm below the tip with round terminus. A cross head speed of 1.00mm/min was applied until post fracture. The value of maximum force applied was obtained in newton (N) was recorded for analysis.

The fracture resistance of the post in the four groups was compared using a one way analysis of variance (ANOVA) using Duncan test.

Fig: 1 Materials used in the study.

Fig:2 Ni-Cr Alloy used for making cast post and crowns

Fig: 3 The press and ceramic furnaces ProgramatEP3000

Fig: 4 Lithium disilicate glass-ceramic (LS_2) ingot used for the pressable ceramic post.

Fig: 5 Prefabricated Cosmo post

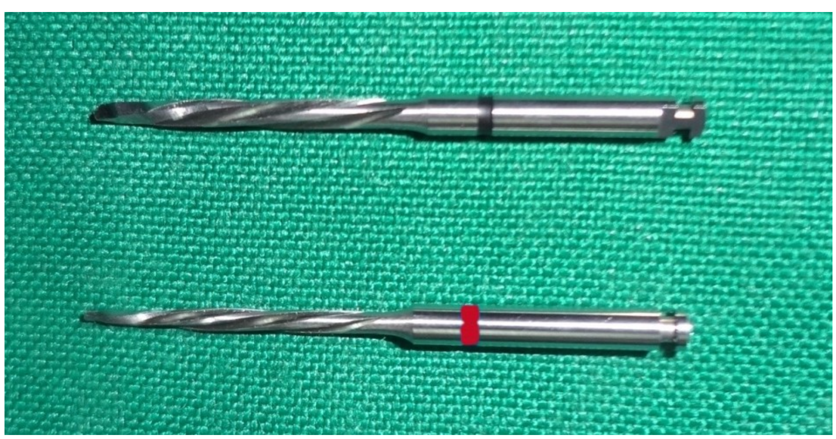

Fig: 6 Cosmo Post Root canal Drill used for post space preparation for standard size 1.4mm and 1.7mm diameter

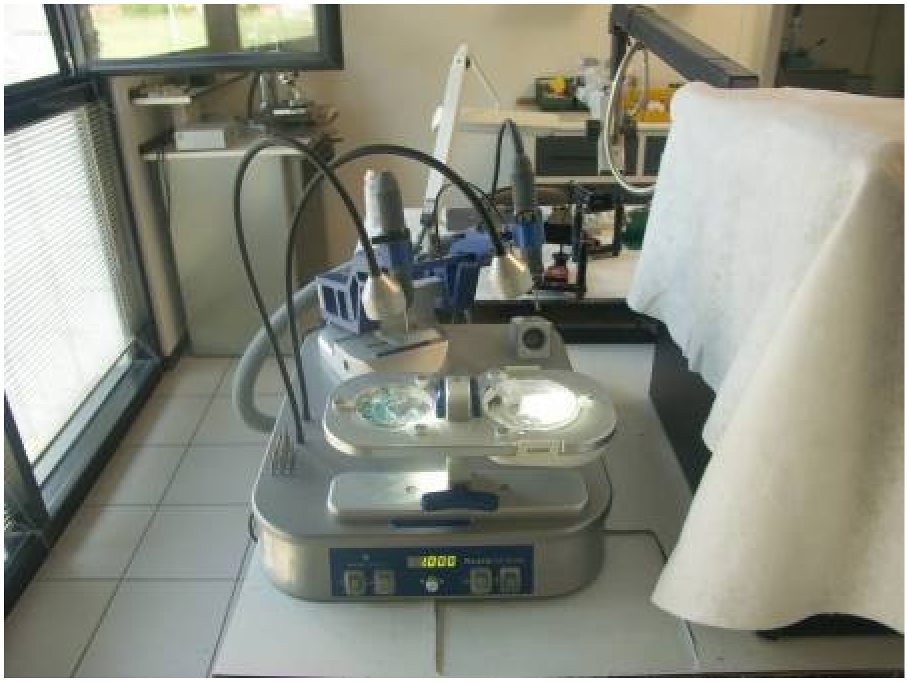

Fig: 7 Ceramill-Multi-X copy milling equipment.

Fig: 8 Ceramill-ZI-Blanks

Fig: 9 ToothSamples after sectioning 15mm from the apex of teeth horizontally

Fig: 10 Specimens after Ferrule preparation

Fig: 11 Specimens after Obturation

Fig: 12 Tooth Specimen with pattern made with pattern resin

Fig 13 Resin pattern of 1.4mm aand 1.7mm post

Fig: 14 Patterns made for Cosmo Post 1.4mm and 1.7mm Diameter.

Fig: 15 Cast Metal Post 1.4mm and 1.7mm diameter.

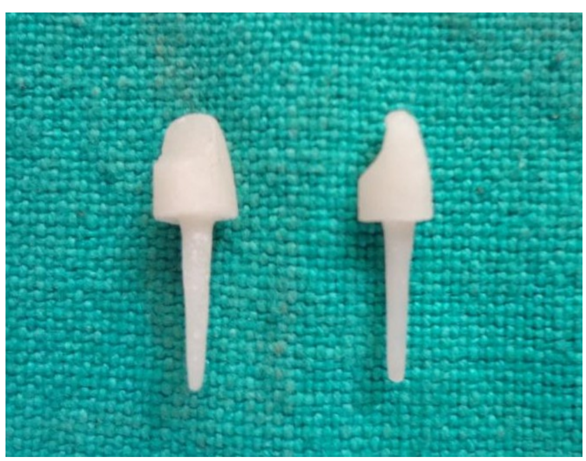

Fig: 16 Pressable Ceramic Post 1.4mm and 1.7mm diameter

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Fig 17 Milled Zirconia Post 1.4mm and 1.7mm Diameter

Fig: 18 Cosmo Post 1.4mm and 1.7mm diameter.

Fig: 19 Full coverage crowns.

Group I Cast Metal Post (Ni-Cr)

Group II Pressable ceramic (PC)

Group III Prefabricated Zirconia – Cosmo Post (CP)

Group IV Milled Zirconia (MZ)

Fig : 20 Specimens used in the study

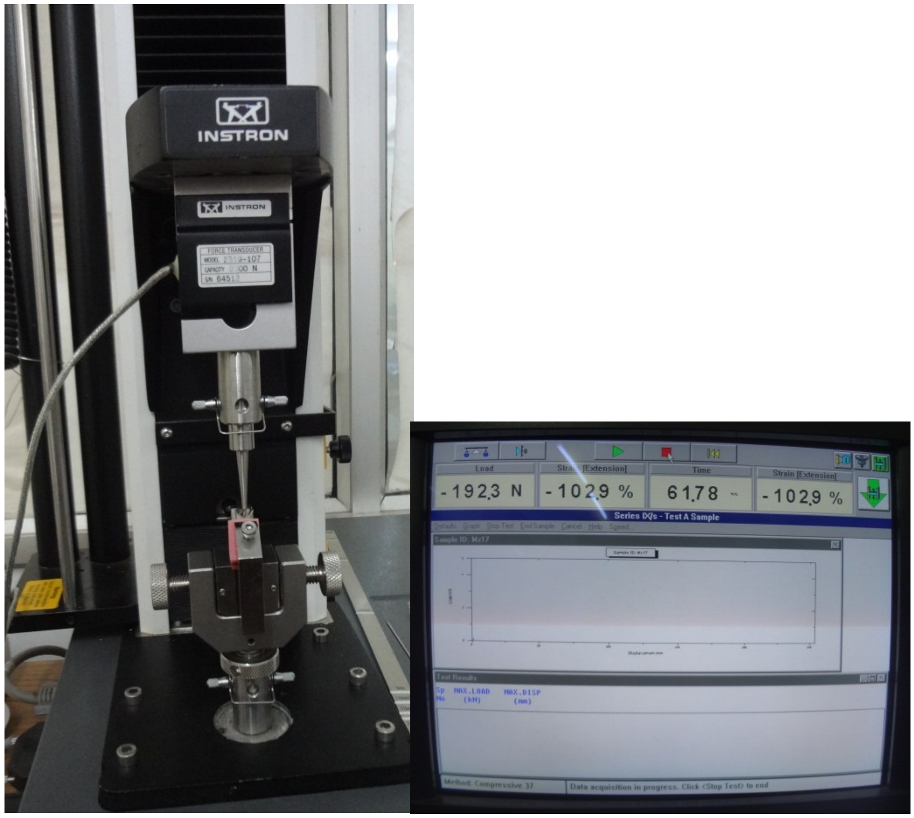

Fig : 21 Instron universal Testing Machine used for testing fracture resistance

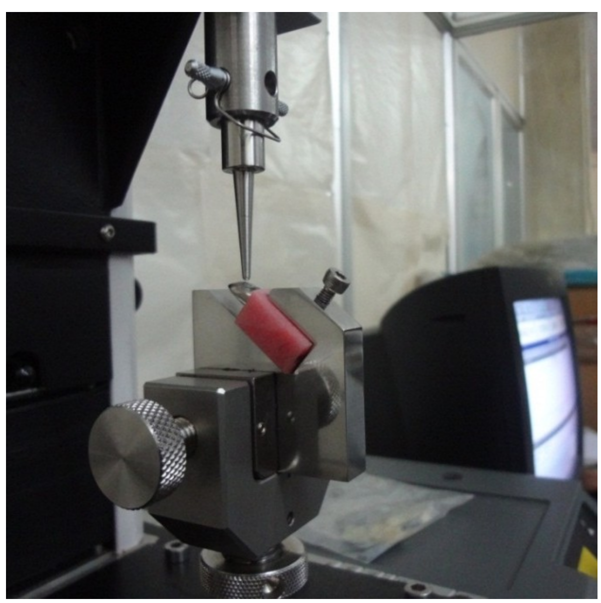

Fig: 22 Mounted Specimen in universal Testing Machine at an angle of 130Degree

Results and Observations

RESULTS AND OBSERVATIONS

The data was Analyzed using computer software, Statistical Package for Social Sciences (SPSS) version 16.0 (SPSS, Inc. Chicago IL). Data expressed in its Mean±SEM (Standard Error of Mean). Analysis of variance one way (ANOVA) was performed as a parametric test to compare different sub groups within each group together. Ducan's Multiple Range (DMR) test was employed as post Hoc tool to compare the Mean value between the four groups with each other of the sub groups. Difference were consider to be significant at $P<0.05$.

Specimens were divided in to four groups. Cast metal post of size 1.4 and 1.7mm diameter denoted as (Ni-Cr). Pressable ceramic post of size 1.4 and 1.7mm is denoted as (PC). Prefabricated Zirconia – Cosmo post of size 1.4and 1.7mm is denoted as (CP). Milled Zirconia post of size 1.4 and 1.7mm is denoted as (MZ)

Specimen of each group were subjected to load to fracture in universal testing machine (Instron model 3345) and the maximum load at failure was recorded, tabulated and shown in the tables 1 to 4. The Mean value ±SEM of fracture resistance of groups were calculated from the test values. In group I

(Ni-Cr) 1.4mm diameter post and cores recorded a maximum fracture load of 534.83±1.28N (Fig:- 23) and 1.7mm showed 294.33±1.02N (Fig: 24)(Table:- 1). In group II (PC) 1.4mm diameter post and cores recorded a maximum fracture load of 205.33±1.61N (Fig:-25) and 1.7mm showed 375.00±1.57N (Fig:-26) (Table:- 2). In group III (CP) 1.4mm diameter post and cores recorded a maximum fracture load of 313.00±0.73N (Fig:-27) and 1.7mm showed 638.67±0.81N (Fig:-28)(Table:- 3).In group IV (MZ) 1.4mm diameter post and cores recorded a maximum fracture load of 312.00±0.86N (Fig:-29) and 1.7mm showed 415.00±0.89N (Fig:-30)(Table:-4).

Comparison of different post having 1.4mm

Fracture load was measured and compared for four different posts having 1.4mm diameter (Table:-5). Cast metal post have (534.83±1.28), Pressable ceramic (205.33±1.61), Prefabricated Zirconia (313.00±0.73) and Milled Zirconia (312.00±0.86). Cast metal post showed significant difference compared with other post. Pressable ceramic have less fracture load than others. There is no significant difference between prefabricated Zirconia and Milled Zirconia. (Fig:-31)

Comparison of different post having 1.7mm

Different post was prepared having 1.7mm diameter and tested for fracture resistance(Table:-6). In this study observation Prefabricated Zirconia (638.67±0.81) showed significant results compared with Cast metal post (294.33±1.02), Pressable ceramic (375.00±1.57) and Milled Zirconia (415.00±0.89). Cast metal post showed low fracture load (Fig:-32).

Comparison of 1.4mm and 1.7 mm posts

In this multiple comparison (Table:-7). Prefabricated Zirconia 1.7mm showed significant difference compared with other groups having different diameters. Pressable ceramic 1.4mm have low fracture load compared with other posts. There is no significant difference compared prefabricated Zirconia 1.4mm with Milled zirconia 1.4mm. From the observations Prefabricated Zirconia 1.7mm (638.67±0.81) have high fracture resistance followed by cast metal post 1.4mm (534.83±1.28). Pressable ceramic 1.4mm (205.33±1.61) and Cast metal post 1.7mm (294.33±102) showed low fracture load. Milled Zirconia 1.4mm and

Prefabricated Zirconia 1.4mm both have almost same fracture load. (Fig:33).

In group I all specimens showed tooth fracture, however, tooth fracture were not observed in group II, III, and IV.

Table-1: Values of Cast metal post (Ni-cr) of 1.4mm and 1.7mm

Sample no	1.4mm (N)	1.7 mm (N)
1	536	296
2	532	293
3	538	298
4	530	291
5	536	293
6	537	295
Mean±SEM	**534.83±1.28**	**294.33±1.02**

Table-2: Values of Pressable ceramic E-Max (PC) of 1.4mm and 1.7mm

Sample no	1.4mm (N)	1.7 mm (N)
1	209	380
2	205	373
3	201	370
4	211	379
5	202	375
6	204	373
Mean±SEM	**205.33±1.61**	**375.00±1.57**

Table-3: Values of Prefabricated Zirconia (Cosmo post) (CP) of 1.4mm and 1.7mm

Sample no	1.4mm (N)	1.7 mm (N)
1	314	640
2	310	635
3	315	638
4	312	640
5	314	639
6	313	640
Mean±SEM	**313.00±0.73**	**638.67±0.81**

Table-4: Values of Milled Zirconia (MZ) of 1.4mm and 1.7mm

Sample no	1.4mm (N)	1.7 mm (N)
1	314	417
2	310	412
3	312	415
4	313	418
5	314	414
6	309	414
Mean±SEM	**312.00±0.86**	**415.00±0.89**

Table-5: Comparison of different post having 1.4mm

Groups	Type of post	Fracture Load (N) (MEAN±SEM)
Group-I	Cast metal post	534.83±1.28
Group-II	Pressable ceramic (E-Max)	205.33±1.61*
Group-III	Prefabricated Zirconia (Cosmoprost)	313.00±0.73*, #
Group-IV	Milled Zirconia	312.00±0.86*, #

(*P<0.05 significant difference compared Cast metal post with other posts, #P<0.05 significant difference compared Pressable ceramic (E-Max) with other posts)

Table-6: Comparison of different post having 1.7mm

Groups	Type of post	Fracture Load (N) (MEAN±SEM)
Group-I	Cast metal post	294.33±1.02
Group-II	Pressable ceramic (E-Max)	375.00±1.57*
Group-III	Prefabricated Zirconia (Cosmopost)	638.67±0.81*,#
Group-IV	Milled Zirconia	415.00±0.89*,#, $

(* P<0.05 significant difference compared Cast metal post with other posts, #P<0.05 significant difference compared Pressable ceramic post with other posts, $P<0.05 significant difference compared Prefabricated Zirconoia post with other posts)

Table-7: Multiple comparisons of different post groups in 1.4 mm and 1.7 mm diameter

Group	Type of post and diameter (mm)	Fracture Load (N) (MEAN±SEM)
Group-I	Cast metal post (Ni-Cr)- 1.4 mm	534.83±1.28
Group-II	Cast metal post (Ni-Cr)- 1.7mm	294.33±1.02[1]
Group-III	Pressable ceramic (E-Max) (PC)- 1.4mm	205.33±1.611,[2]
Group-IV	Pressable ceramic (E-Max) (PC)- 1.7mm	375.00±1.57[1,2,3]
Group-V	Prefabricated Zirconia (Cosmopost) (CP)- 1.4mm	313.00±0.73[1,2,3,4]
Group-VI	Prefabricated Zirconia (Cosmopost) (CP)- 1.7 mm	638.67±0.81[1,2,3,4,5]
Group-VII	Milled Zirconia (MZ)- 1.4mm	312.00±0.86[1,2,3,4,6]
Group-VIII	Milled Zirconia (MZ)- 1.7mm	415.00±0.89[1,2,3,4,5,6,7]

(1P<0.05 significant compared Cast metal post (Ni-Cr)- 1.4 mm with other posts, 2P<0.05 significant compared Cast metal post (Ni-Cr)- 1.7 mm with other posts, 3P<0.05 significant Pressable ceramic (E-Max) (PC)- 1.4mm with other posts, 4P<0.05 significant compared Pressable ceramic (E-Max) (PC)- 1.7mm with other posts, 5P<0.05 significant compared Prefabricated Zirconia (Cosmopost) (CP)- 1.4mm with other posts, 6P<0.05 significant compared Prefabricated Zirconia (Cosmopost) (CP)- 1.7mm with other posts, 7P<0.05 significant Milled Zirconia (MZ)- 1.4mm with other posts)

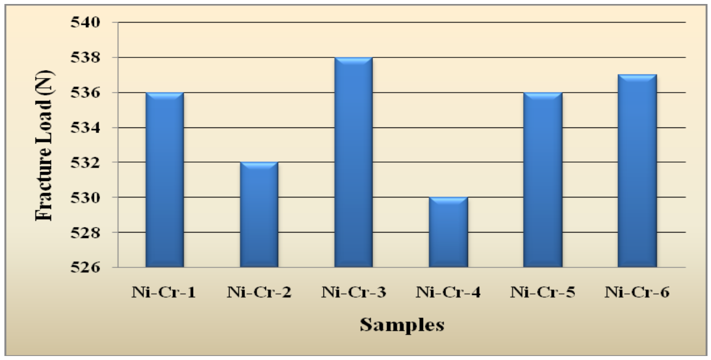

Fig 23: Values of Cast metal post (Ni-cr) of 1.4mm

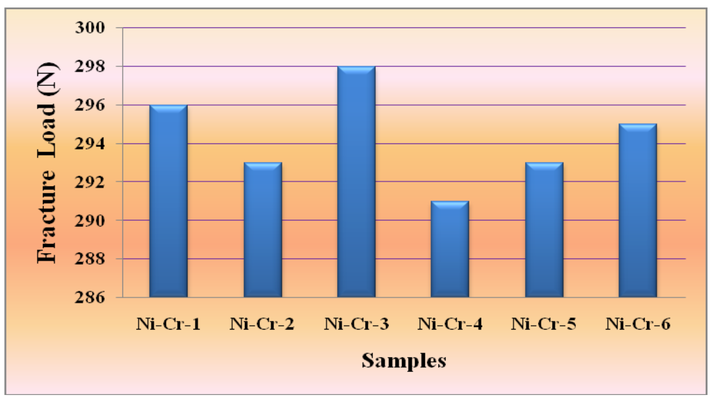

Fig 24: Values of Cast metal post (Ni-cr) of 1.7mm

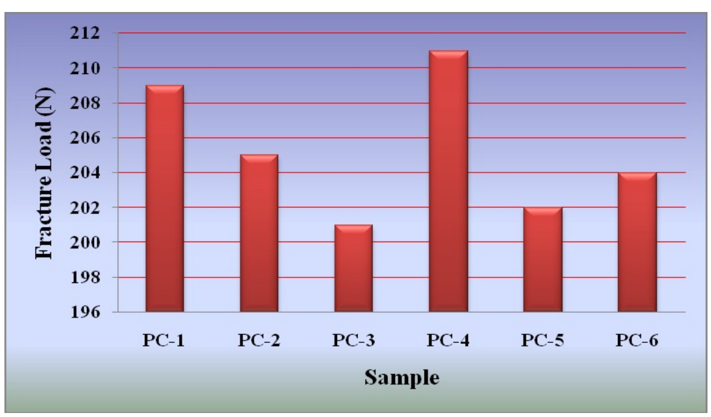

Fig 25: Values of Pressable ceramic (E-Max) of 1.4mm

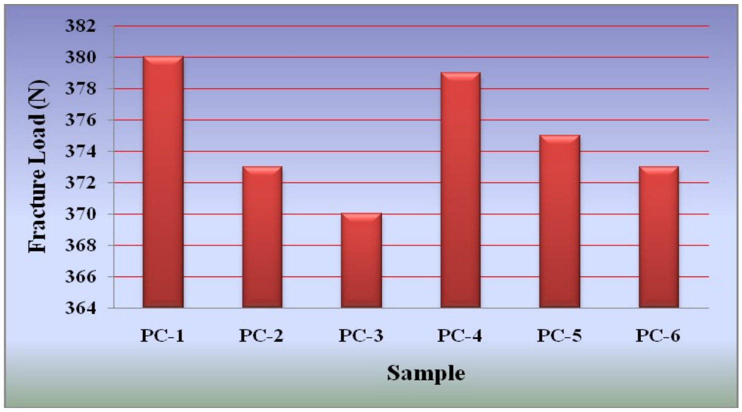

Fig 26: Values of Pressable ceramic (E-Max) of 1.7mm

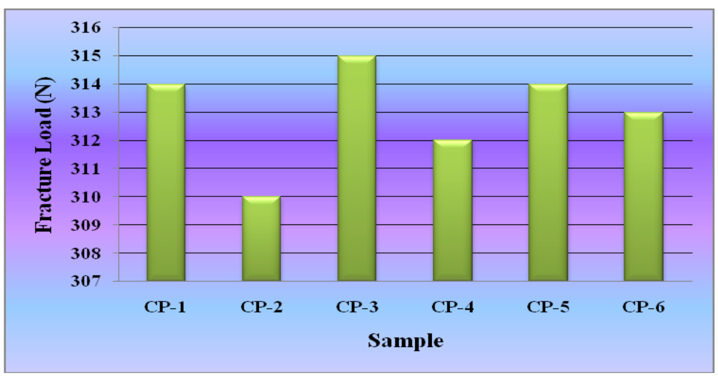

Fig 27: Values of Prefabricated Zirconia (Cosmoprost) of 1.4mm

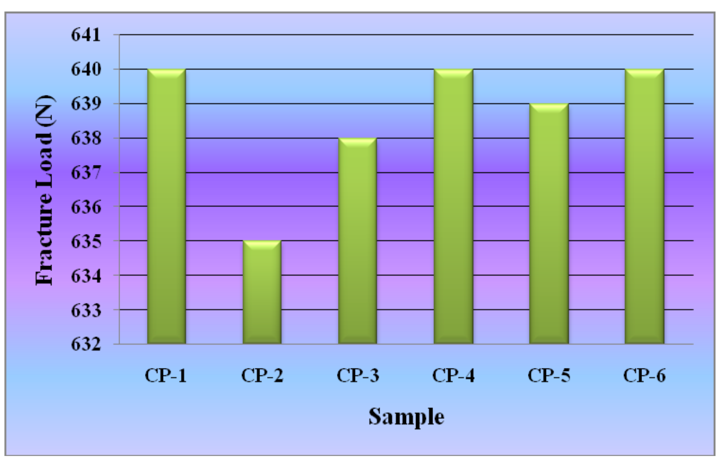

Fig 28: Values of Prefabricated Zirconia (Cosmoprost) of 1.7m

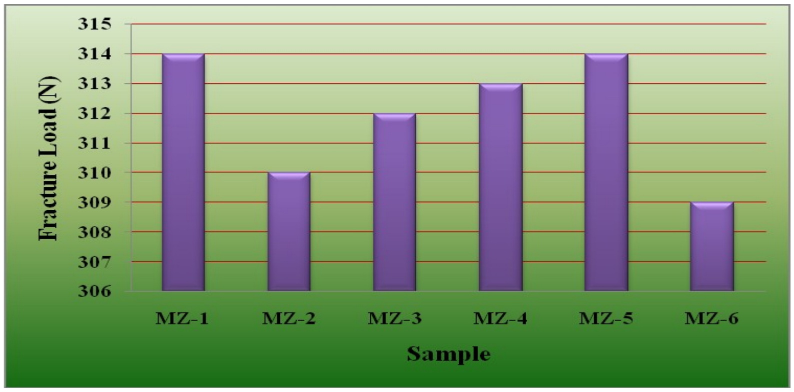

Fig 29: Values of Milled Zirconia of 1.4mm

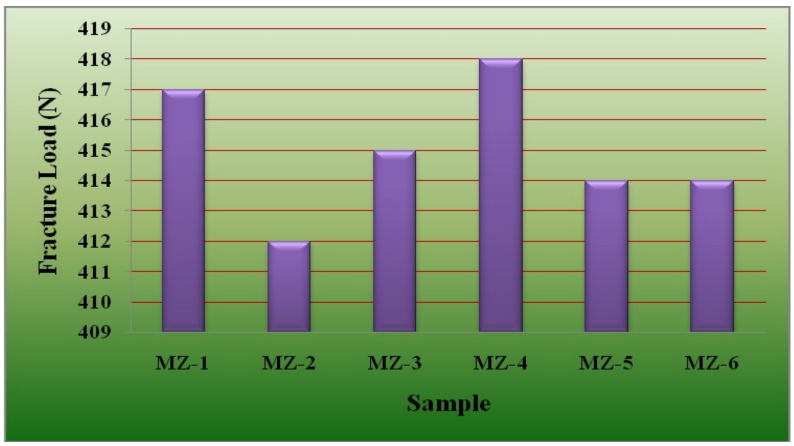

Fig 30: Values of Milled Zirconia of 1.7mm

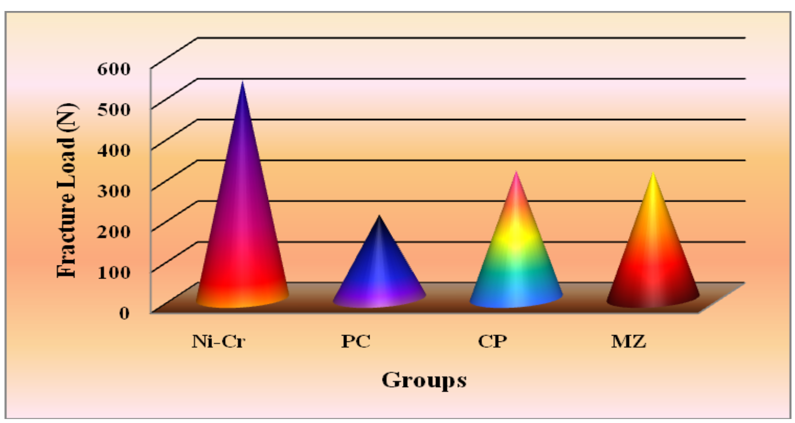

Figure 31: Comparison of different post having 1.4mm

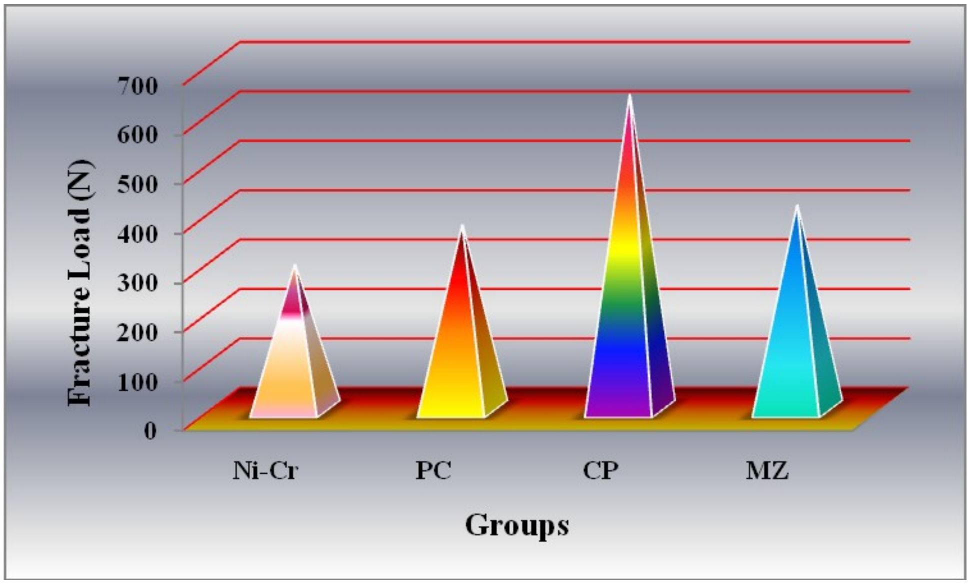

Figure 32: Comparison of different post having 1.7mm

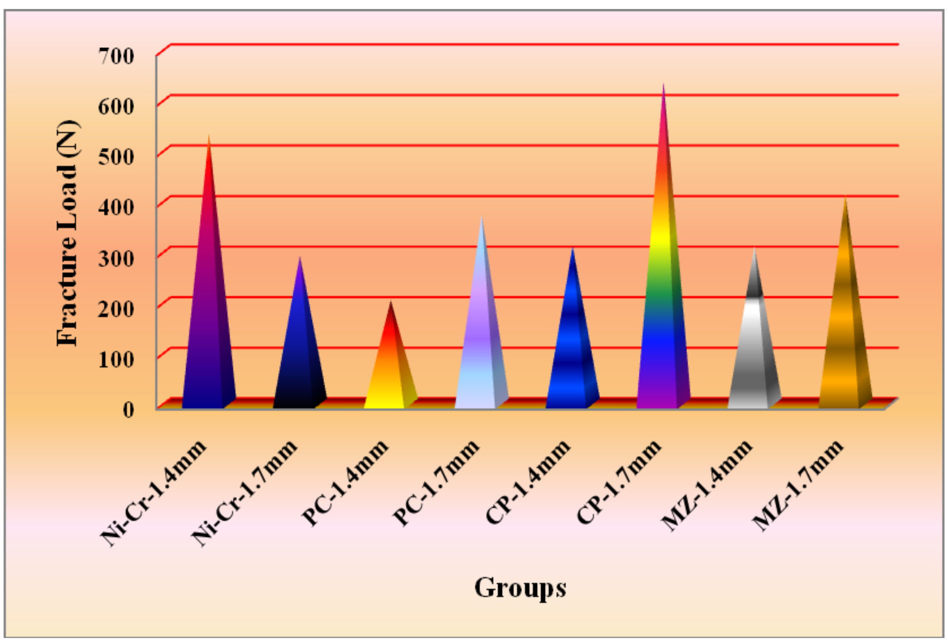

Figure 33: Multiple comparisons of different post groups in 1.4 mm and 1.7 mm diameter

Discussion

DISCUSSION

In the case of substantial horizontal loss of clinical crown, there is no restorative alternative to fabrication of a post and core build up. The current study attempted to compare the conventional metal post and core with newer all ceramic. In the present study compare fracture resistance of teeth restored with 4 different post and core system. 48 freshly extracted human maxillary central incisor teeth were taken for preparation of specimen. Six specimens in each group were taken for 1.4mm and 1.7mm diameter. Group I (Cast metal post) Group II (Pressable ceramic) Group III (Prefabricated Zirconia with pressable ceramic core) Group IV (Milled Zirconia)

All teeth were decoronated at the 15mm from the apex to simulate the commonly encountered clinical situation of lost tooth structure. All root received endodontic treatment and care was taken in the preparation of standard post space. Variation in post length is eliminated by choosing a standard length of 11mm and the procedure also enable the formation of group with similar post diameter 1.4mm and 1.7mm by using standard root canal drill of size 1.4 and 1.7mm diameter.

The posts were cemented with resin cement. A reliable choice of luting cement for post cementation contributes towards preventing coronal leakage with post and core. It's recommended to use resin cement because they have been shown to produce higher bonding to tooth post surface and dentine when compared to other cements[19]. Resin cements are affected by eugenol-containing root canal sealers, which should be removed by irrigation. In a study comparing fracture resistance of post and core using various cements, resin cement appeared to have significantly higher fracture resistance when compared to other cement[6].

The radicular portion of each tooth was embedded in repair acrylic resin 2mm below the proximal cement-enamel junction this simulated the clinical biological distance. In the study all specimens were restored and luted with complete coverage metal crown to ensure standardization. With the use of jig the central block directed the load at an angle of 130 degree to central long axis of root. This configuration provided an even distribution of force along perpendicular axis of the root and also replicated flexion stress resulting from protrusive movements. Guzy and micholis reported that, for incisor teeth a loading angle of 130 degree was chosen to simulate a contact angle found in class I occlusion between maxillary and mandibular teeth[16].

Ideal post system should have the following features: Physical properties similar to dentine, maximum retention with little removal of dentine, maximum distribution of functional stresses evenly along root surface, esthetic compatibility with the definitive restorations and surrounding tissue, good core retention, ease of use[6.19.49,50].

There are number of parameters in the design of post and core that influence the success and fracture of the restoration of an endodontically treated tooth. Post and core retention is generally associated with length of post, parallel sided post wall and surface concentration whereas resistance to root fracture is influenced by length of post and its diameter, fracture resistance increases when the length of post increases[49,50]. In a study comparing fracture resistance of post and core having different post length of 10mm and 5mm, where 10mm post length groups have significant higher mean fracture load when compared with 5mm post length[37].

A post that is too short will fail, whereas one that is too long may damage the seal of the root canal fill or risk root perforation if the apical third is curved or tapered. Absolute guidelines for optimal post length are difficult to define. Ideal post length should be longer than crown and it should be two thirds the length of the root whichever is greater. The post should be as long as possible without jeopardizing the apical seal or the strength or integrity of the remaining root structure. A minimum length of 4.0mm of gutta-percha should remain at the apex to prevent dislodgement and leakage[49,50]. Goodacre and spoolnik recommended 4-5mm gutta-percha remaining apically to maintain the apical seal. Dye penetration studies to indicate leakage showed root canal sealed with lateral condensation of gutta-percha showed no adverse leakage effect[1]. Studies have demonstrated that cast post group showed significantly higher level of microleakage compare with other group under dynamic loading[28].

Endodontically treated teeth often have lost much coronal tooth structure as a result of caries, of previously placed restorations, or in preparation of the endodontic access cavity. However, if a cast core is to be used, further reduction is needed to accommodate a complete crown and to remove undercuts from the chamber and internal walls. This may leave very little coronal dentin. Every effort should be made to save as much of the coronal tooth structure as possible, because this helps reduce stress concentrations at the gingival margin. The amount of remaining tooth structure is probably the single most important predictor of clinical success[50]. Extension of the axial wall of the crown apical to the missing tooth structure provides what is known as a ferrule and is thought to help bind the remaining tooth structure together, preventing root fracture during function. Although there is evidence that preserving as much coronal tooth structure as possible will enhance prognosis, it is less clear whether the prognosis will improve by creating a ferrule in an extensively damaged tooth by surgical crown-lengthening[19,49,50]. When the supra-marginal dentine of a root filled is engaged by crown, it may create a stronger tooth restoration complex this is called ferrule effect[33]. Studies demonstrated that those tooth prepared with 2mm ferrule effectively enhanced the fracture strength of endodontically treated tooth of maxillary central incisors[3,18,22,34,35].

In the present study cast metal post of diameter 1.4mm showed highest fracture resistance whereas 1.7mm diameter cast metal post showed the lowest fracture resistance when compared with the other post groups. It has been reported that more rigid post and core are unable to absorb stress and if the post space preparation is more it’s susceptible to fracture. When creating post space, great care must be used to remove only minimal tooth structure from the canal. Excessive enlargement can perforate or weaken the root, which then may split during cementation of the post or subsequent function. The thickness of the remaining dentin is the prime variable in fracture resistance of the root[36]. Antony etal[2] investigated the significant amount of remaining buccal dentine of the dowel channel in resisting root fracture under horizontally directed load showed that 1mm remaining buccal dentinal walls were apparently more prone to fracture than 2 or 3mm buccal dentinal wall[2,36].

It has not been demonstrated experimentally that endodontically treated teeth are weaker or more brittle than vital teeth. Their moisture content, however, may be reduced.' Laboratory testing' has actually revealed a similar resistance to fracture between untreated and endodontically treated anterior teeth. Nevertheless, clinical fracture does occur, and attempts have been made to strengthen the tooth by removing part of the root canal filling and replacing it with a metal post. In reality, placement of a post requires the removal of additional tooth structure which is likely to weaken the tooth[50].

Teeth with larger diameter have reduced fracture resistance than the teeth with similar diameter[31]. In a study to measure fracture resistance of extracted tooth restored with 2 different diameters cast metal post demonstrated that for smaller diameter post showed higher fracture resistance than wider diameter[26]. Experimental impact testing of teeth with cemented posts of different diameters' showed that teeth with a thicker (1.8 mm) post fractured more easily than those with a thinner (1.3 mm). Metal and prefabricated ceramic post exhibit higher elastic moduli than dentine. Mozavi etal studied the effect of post diameter on stress distribution in maxillary incisor by 3D finite element study, they stated that tensile strength and compressive stress in post increased when the post diameter increased amount of stress generated in post increased by increasing in post diameter so preserving the tooth structure by use of narrow post is recommended[20]. Cast metal post have higher level of stress concentration when compared with other post because of the rigidity and higher modulus of elasticity making the endodontically treated tooth susceptible to root fracture[45,47].

All-ceramic materials have been used as foundation restorations for endodontically treated teeth to overcome esthetic problems associated with metal post-and-core systems. The post is made of zirconia, chosen for its excellent strength, and depending on the system, the core material can be composite resin or a pressable ceramic. All ceramic post have many advantage lie in its translucency and tooth colored shade, there by rending the material usable with all ceramic crowns in the anterior region. In particular patients who have high lip line and thin gingival tissue would require the use of all ceramic post with all ceramic crowns to optimize the aesthetic effect at the root while maintaining an adequate level of strength[29,39,50].

In the present study pressable ceramic post of diameter 1.4mm showed the lowest values when compared with the other post groups but it's usable. It has more strength than prefabricate metal post with composite core and glass fiber post. Whereas prefabricated zirconia and milled zirconia post and core exhibit the same fracture resistance. A similar study comparing zirconia post by three different methods and reported that milled zirconia restoration and prefabricated zirconia with pressable ceramic core buildups did not demonstrate any difference in fracture resistance[8,12].

In the present study with lesser diameter (1.4mm), ceramic post showed lower values but cast post showed higher values. While comparing 1.7mm diameter post and core groups, the prefabricated zirconia post showed the highest value and cast metal post showed the lowest value and milled zirconia stood next to prefabricated zirconia followed by pressable ceramic. Previous studies of copy milled zirconia post are significantly lower than that of prefabricated zirconia post of same size[24]. In another study comparing one piece milled zirconia post and core with glass fiber post system presented, one piece milled zirconia post and core showed higher load bearing capacity when comparing with other post[8].

In general with higher diameter ceramic post rendered higher values but cast metal post showed lower values. Frank butz etal[12] reported that zirconia post with ceramic core exhibited less vertical fracture of tooth than metal post combinations. Zirconia post with ceramic core can be recommended as an alternative to cast post in anterior region[12,5].

Currently in prosthodontics zirconia is a widely used material because of its good chemical stability, high mechanical strength, high toughness and young's modulus similar to that of stainless steel alloy. Apart from its favorable chemical and physical properties zirconia also wields the aesthetic advantage of having a color similar to that of natural teeth[24,39].

In the present study comparing 1.4mm and 1.7mm post and core groups, 1.4mm metal post and core showed superior values when compared with 1.7mm post, but all the ceramic post of 1.4mm diameter recorded lesser values when compared with 1.7mm post. All ceramic post of 1.7mm diameter exhibited excellent fracture resistance. As the diameter of post increased a corresponding increase in fracture resistance was also noticed in all ceramic post and core groups.

In multiple comparisons prefabricated zirconia post of 1.7mm showed the highest value and found to be the best system, followed by cast metal post of 1.4mm. Pressable ceramic with 1.4mm post and cast metal post of 1.7mm showed low fracture resistance. Prefabricated zirconia and milled zirconia post of 1.4mm diameter expressed the same values. Pressable ceramic and milled zirconia of 1.7mm showed satisfactory values and exhibited good fracture resistance.

One cast metal post and three ceramic post and core system groups were evaluated in this study. Cast metal post of 1.4mm showed high fracture resistance when compared to 1.7mm post with significant difference on metal post of lesser diameter showed better results.

The specimen with metal post showed tooth fracture with intact post. At the fracture load the specimen with ceramic post showed fracture of post. Limitation of this study was that it was an in vitro study and result obtained may not be comparable to in vitro situations. Some factors such as quantity and quality of remaining tooth structure can explain the variation in the result.

Conclusion

CONCLUSION

In the present study fracture resistance of cast metal post and ceramic post systems of 1.4mm and 1.7mm diameter was analyzed.

Cast metal post and core of lesser diameter (1.4mm) showed higher fracture resistance. All specimens with cast metal post and core showed fracture of tooth, whereas all ceramic post and core specimen showed fracture of post. So lesser diameter of cast metal post are recommended.

All ceramic post with higher diameter showed better results (ie) 1.7mm is superior to 1.4mm post. No fracture of teeth was observed with ceramic post. These shows that 1.7mm ceramic post are safe.

Among the ceramic post and core prefabricated zirconia post with pressable ceramic core (Cosmo post) exhibited higher fracture resistance. 1.7mm diameter post shows better results. This post and core system can be considered as ideal material of choice among the tested groups.

Milled zirconia showed satisfactory result with 1.4 and 1.7mm diameter post. Milled zirconia and prefabricated zirconia post showed same value with 1.4mm diameter post. Milled zirconia is a good option as post and core along with cosmo post in prosthodontics.

Pressable ceramic post and core showed satisfactory result with 1.7mm post but showed lesser values with 1.4mm diameter post. 1.7mm pressable ceramic post and core is superior to the same size cast metal post. Pressable ceramic post and core can also include in prosthodontics for the restoration of anterior teeth. It’s comparatively cheap and easily fabricated by lost wax technique.

All ceramic post and core system tested in this study showed satisfactory result. This can be utilized successfully in prosthodontics for restoration of grossly decayed endodontically treated anterior teeth- A PROMISE AND RELIEF TO AESTHETIC DENTISTRY.

Bibliography

BIBLIOGRAPHY

1. **Ross L. Neagley.** The effect of dowel preparation on the apical seal of endodontically treated teeth. O.S., O.M. & O.P. November 1969;28(5):739-745.
2. **Anthony H. L. Tjan, Sung B. Whang.** Resistance to root fracture of dowel channels with various thicknesses of buccal dentin walls. Journal of prosthet dent 1985:53:496-500.
3. **John A. Sorensen, Michael J. Engelman.** Ferrule design and fracture resistance of endodontically treated teeth. J Prosthet Dent 1990;63:529-536.
4. **Arturo Martinez-Insu, Luis Da Silva, Benito Rilo.** Comparison of the fracture resistances of pulpless teeth restored with a cast post and core or carbon-fiber post with a composite core. J Prosthet Dent 1998;80:527-532.
5. **N. Hochman, M. Zalkind.** New all-ceramic indirect post-and-core system. J Prosthet Dent 1999;81:625-629.
6. **Lawrence W. Stockton.** Factors affecting retention of post systems: A literature review. J Prosthet Dent 1999;81:380-385.

7. **SonthiSirimai, Douglas N. Riis.** An in vitro study of the fracture resistance and the incidence of vertical root fracture of pulpless teeth restored with six post-and-core systems. J Prosthet Dent 1999;81:262-269.

8. **Seung-MiJeong, Chae-Heon Chung,Dong-Wan Kang.** Evaluation of the fracture resistance of all-ceramic zirconia posts by 3 different methods. J Korean AcadProsthodont 2000;38(6):757-764.

9. **Clarence J.Cormier,David R. Burns.** Invitro comparison of fracture resistance & failure mode of fibre, ceramic& conventional post systems at various stages of restoration. J Prosthodont 2001;10:26-36.

10. **Guido Heydeckea, FrankButzb, Jorg R. Strub.** Fracture strength and survival rate of endodontically treated maxillary incisors with approximal cavities after restoration with different post and core systems: an in-vitro study.JOD 2001:29:427-433.

11. **Joachim Tinschert, GerdNatt, Walter Mautsch.** Fracture Resistance of Lithium-Disilicate–, Alumina-, and Zirconia-Based Three-Unit Fixed Partial Dentures: A Laboratory Study. Int J Prosthodont 2001;14:231–238.

12. **Frank Butz, Áine M. Lennon.** Survival Rate and Fracture Strength of Endodontically Treated Maxillary Incisors with Moderate Defects

Restored with DifferentPost-and-Core Systems: An In Vitro Study.Int J Prosthodont 2001;14:58–64.

13.**Guido Heydecke, Mathilde C. Peters.** The restoration of endodontically treated, single-rooted teeth with cast or direct posts and cores: A systematic review. J Prosthet Dent 2002;87:380-386.

14.**Guido Heydecke, Frank Butz.** Fracture strength after dynamic loading of endodontically treated teeth restored with different post-and-core systems. J Prosthet Dent 2002;87:438-445.

15.**Steven A. Aquilin, Daniel J. Caplan.** Relationship between crown placement and the survival of endodontically treated teeth. J Prosthet Dent 2002;87:256-263.

16.**BegümAkkayan, TurgutGülmez.** Resistance to fracture of endodontically treated teeth restored with different post systems. J Prosthet Dent 2002; 87:431-437.

17.**Aquaviva S. Fernandes, SharatShetty.** Factors determining post selection: A literature review. J Prosthet Dent 2003;90:556-562.

18.**Lu Zhi-Yue, Zhang Yu-Xing.** Effects of post-core design and ferrule on fracture resistance of endodontically treated maxillary central incisors. J Prosthet Dent 2003;89:368-373.

19. **Richard S. Schwart, James W. Robbin.** Post placement and restoration of endodontically treated teeth: A Literature Review. Journal of endodontics 2004 : 30(5):289-301.

20. **A. Monzavi1, S. Nokar1, HR. Javadi.** The Effects of Post Diameter on Stress Distribution in Maxillary Central Incisor-A Three Dimensional Finite Element Study. Journal of Dentistry, Tehran University of Medical Sciences,2004;1(2):17-23.

21. **Ingrid Peroz, FelixBlankenstein, Klaus Peter.** Restoring endodontically treated teeth with posts &cores. Quintessence Int 2005;36:737-746.

22. **Philip L.B. Tan, MS,Steven A. Aquilino.** In vitro fracture resistance of endodontically treated central incisors with varying ferrule heights and configurations. J Prosthet Dent 2005;93:331-336.

23. **Erik Asmussen, CandScient, Anne Peutzfeldt, bAlirezaSahafi.** Finite element analysis of stresses in endodontically treated, dowel-restored teeth. J Prosthet Dent 2005;94:321-329.

24. **Zhang yu-xing, Zhang wei-hong.** Fracture resistance of custom-fabricated celay all ceramic post and core restored endodontically treated tooth. Chinese medical journal;2006;119(21):1815-1820.

25. **M.Sadeghi.** A Comparison of the Fracture Resistance of Endodontically Treated Teeth using Three Different Post Systems. Journal of Dentistry, Tehran University of Medical Sciences, Tehran, Iran 2006;3 (2):69-76.

26. **LinardsGrieznis, Peteris Apse, UnaSoboleva.** The effect of 2 different diameter cast posts on tooth-root fracture resistance in vitro. Stomatologija, Baltic Dental and Maxillofacial Journal 2006; 8:30-32.

27. **Mikako Hayashi, Yutaka Takahashi, Satoshi Imazato.** Fracture resistance of pulpless teeth restored with post-cores and crowns. Dental Materials 2006: 22: 477–485.

28. **Sung-Ho Jung, Kyung-San Min.** Microleakage and fracture patterns of teeth restored with different posts under dynamic loading. J Prosthet Dent 2007;98:270-276.

29. **Ai B Streacker. Marc Geissberger.** The milled ceramic post and core: A functional and aesthetic alternative. J Prosthetic dent 2007;98:486-487

30. **Hai Qing, MMed, ZhiMin Zhu, YongLie Chao**. In vitro evaluation of the fracture resistance of anterior endodontically treated teeth restored with glass fiber and zircon posts. J Prosthet Dent 2007;97:93-98.

31. **Pérez C. González, J.L. Sancho and P.J. Rodríguez.** Effect of post design on endodontically restored teeth. Contributions to science 2007; 3 (4): 523–530.

32. **Ahed M. AL-Wahadni, Sami Hamdan, Muhanad M. Hatamleh.** Fracture resistance of teeth restored with different post systems: in vitro study. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2008;106:77-83.

33. **Nikolai Stankiewicz, Peter Wilson.** The Ferrule Effect. Dent Update 2008; 35: 222-228.

34. **Polly S. M, Jack I. Nicholls, Thomas Junge, Keith M. Phillips.** Load fatigue of teeth with different ferrule lengths, restored with fiber posts, composite resin cores, and all-ceramic crowns. J Prosthet Dent 2009;102:229-234.

35. **N.Azadzadeh,M.Seify**. Evaluation of fracture resistance in endodontically treated teeth through four restorative methods. An in vitro study. J. Med. Sci 2009;9(3):156-160.

36. **B. H. Kıvanc¸ , T. Alac¸am, I. A. Ulusoy.** Fracture resistance of thin-walled roots restored with different post systems. International Endodontic Journal 2009;42: 997–1003.

37. **John D. McLaren, Charles I. McLaren.** The effect of post type and length on the fracture resistance of endodontically treated teeth. J Prosthet Dent 2009;101:174-182.

38. **Alessandro RogérioGiovani, LuizPascoalVansan, ManoelDamião de Sousa Neto**. In vitro fracture resistance of glass-fiber and cast metal posts with different lengths. J Prosthet Dent2009;101:183-188.

39. **ZeynepOZKURT, Ufuk ISERI and Ender KAZAZOĞLU.** Zirconia ceramic post systems: a literature review and a case report. Dental Materials Journal 2010; 29(3): 233–245.

40. .**Nurit Bittner, Thomas Hill, Anthony Randi.** Evaluation of a one-piece milled zirconia post and core with different post-and core systems: An in vitro study. J Prosthet Dent 2010;103:369-379.

41. **MalathiDayalan, AbhishekJairaj,K. R. Nagaraj, Ravindra C. Savadi.** An Evaluation of Fracture Strength of Zirconium Oxide Posts Fabricated Using CAD-CAM Technology Compared with Prefabricated Glass Fibre Posts. J Indian Prosthodont Soc 2010; 10(4):213–218.

42. **Srividya S., Chandrasekharan Nair K., JayakarShetty.** Fabricating Ceramic posts using CAD/CAM technology. TPDI 2010;1(1):11-13.

43.**Nina Beck, Friedrich Graef, Manfred Wichmann.** In vitro fracture resistance of copy-milled zirconia ceramic posts. Journal of prosthet dent 2010:103:45-49.

44.**Shu-Fen Chuang, Peter Yama.** Influence of post material and length on endodontically treated incisors: An in vitro and finite element study. J Prosthet Dent2010;104:379-388.

45.**JasjitKaur, P.R.Verma**. Fracture resistance of endodontically treated teeth restored with different post systems-A Comparative Study. Indian Journal of Dental Sciences 2011;3:5-9.

46.**Jens T. Mangold, Matthias Kern.** Influence of glass-fiber posts on the fracture resistance and failure pattern of endodontically treated premolars with varying substance loss: An in vitro study. J Prosthet Dent 2011;105:387-393.

47.**VaidyaVidya N, ChitnisDeepa P.** A comparative evaluation of the fracture resistance of endodontically treated teeth with compromised intra radicular tooth structure using three different post system. People's Journal of Scientific Research 2011;4(1):6-11.

48.**Zarb-Bolender.** Prosthodontic treatment for edentulous patients complete denture and implant-supported prosthesis. Twelfth Edition 2009.

49. **Herbert T. shillinburg, Sumiya hobo, Lowell.** Fundemental of fixed prosthodontics. Third Edition .1997.

50. **Stephen F. Rosenstiel, Martin F. Land, Junhei Fujimoto**. Contemporary Fixed Prosthodontics. 4th Edition. 2006.

51. **Kenneth J Anusavice**. Phillips′ Science of Dental Materials. 11^{th} Edition.2003